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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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NOAA Technical Memorandum NMFS

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ABSTRACT

The endangered Hawaiian monk seal, *Monachus schauinslandi*, and the threatened green turtle, *Chelonia mydas*, were studied intermittently on Lisianski Island throughout the summer in 1986. Field personnel were present on three occasions: 3 May, 30 May-2 June, and 5-26 August 1986. A total of 10 censuses were conducted; seal beach counts ranged from 76 to 107 (excluding pups), with a mean of 94. Twenty live pups were tagged after weaning, and two pup carcasses were found. Two adult female seals were seen with fresh dorsal wounds, and up to six adult and subadult females were seen with older, healing dorsal wounds. Eight green turtles were identified by tags: five were tag resightings from previous years and three were newly tagged in 1986. An adult green turtle was found dead, and 15 individual turtle nest sites were located. A total of 174 net and debris items capable of entangling seals and turtles were inventoried and destroyed. Two seals were found entangled in debris and were immediately released.

CONTENTS

INTRODUCTION

Lisianski Island is one of the nine reported haul-out and pupping locations of the endangered Hawaiian monk seal, *Monachus schauinslandi*, and is also a nesting, basking, and feeding area for the threatened green turtle, *Chelonia mydas*, in the Northwestern Hawaiian Islands (NWHI). The National Marine Fisheries Service (NMFS) Honolulu Laboratory has established annual 1- to 6-mo field camps on Lisianski Island since 1981 for monk seal and green turtle research (DeLong et al. 1984; Stone 1984; Johanos and Henderson 1986; Johanos and Kam 1986; Kam 1986; Alcorn et al. 1988; Kam[1]). The purpose of the research is to monitor these two species and aid in their recovery.

The primary objective of this paper is to report the findings of the 1986 Lisianski Island field research. It is not intended to present and review other monk seal and turtle research.

STUDY SITE

Lisianski Island (lat. 26°02'N, long. 174°00'W) is a low-lying, coral and sand atoll located on Neva Shoal, a shallow reef bank in the NWHI (Fig. 1). The island is situated 905 nmi northwest of Honolulu. The interior of the island is densely covered with vegetation (vines, grasses, and shrubs), and the beaches are fairly steep and narrow, except for the southeast portion where they are quite flat and wide. There are also rocky ledges scattered along the east side of the island. The maximum elevation of Lisianski Island is just over 6 m. For more detailed information on geography, flora and fauna, and history of Lisianski Island, see Clapp and Wirtz (1975).

The island perimeter (about 5.2 km) was divided into 49 sectors (Fig. 2) in 1982 (Stone 1984) for recording the locations of animals and other observations; these sectors have been used in successive years' research, including 1986.

METHODS

The NMFS personnel visited Lisianski Island on three different occasions during the 1986 field season (Appendix A): 3 May, 30 May-2 June, and 5-26 August. On 3 May, personnel conducted an island circuit to photograph and draw scar cards of nursing female monk seals, tag weaned pups, resight tagged animals, and note any injured, dead, or entangled seals. Similar activities also were conducted from 30 May to 2 June when a short field camp was established.

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[1]Kam, A. K. H. 1985. Green turtle research on Lisianski Island, 1983. Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Southwest Fish Cent. Admin. Rep. H-85-11, 11 p.

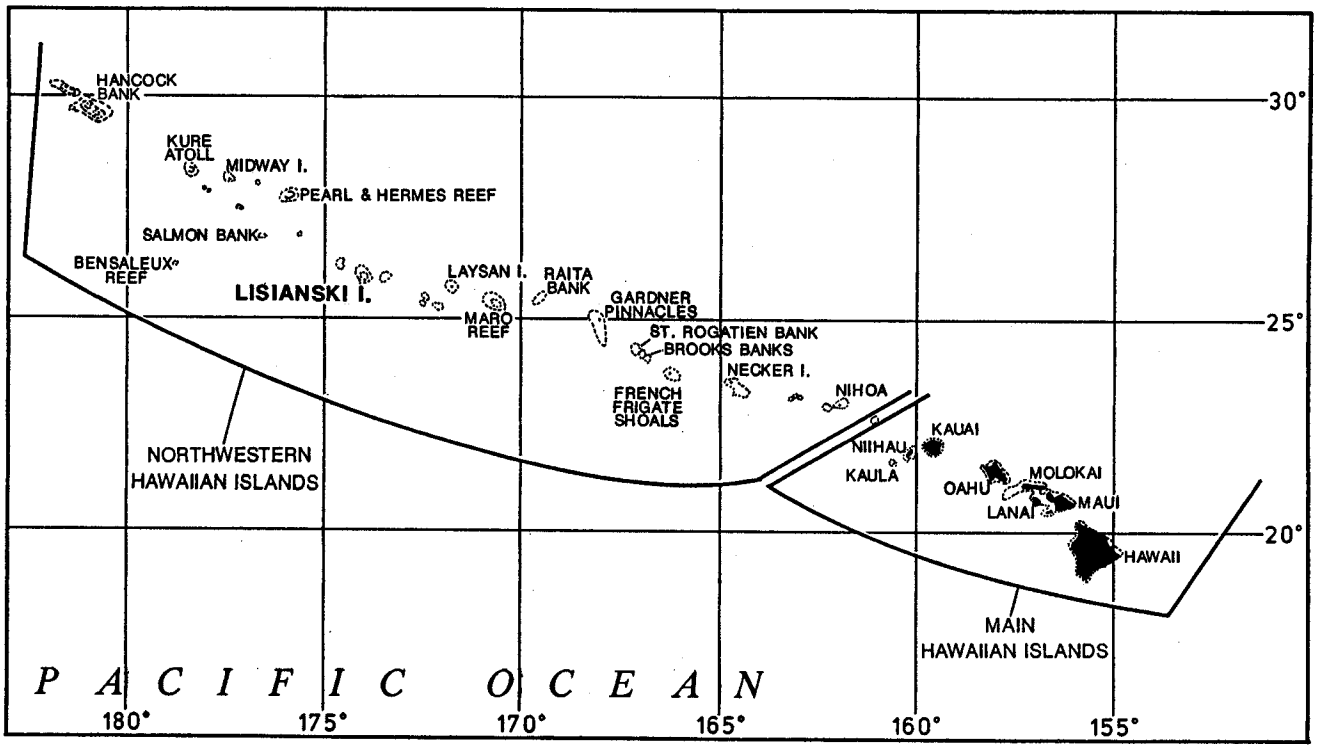

Figure 1.--Chart of Hawaiian Archipelago, showing location of Lisianski Island.

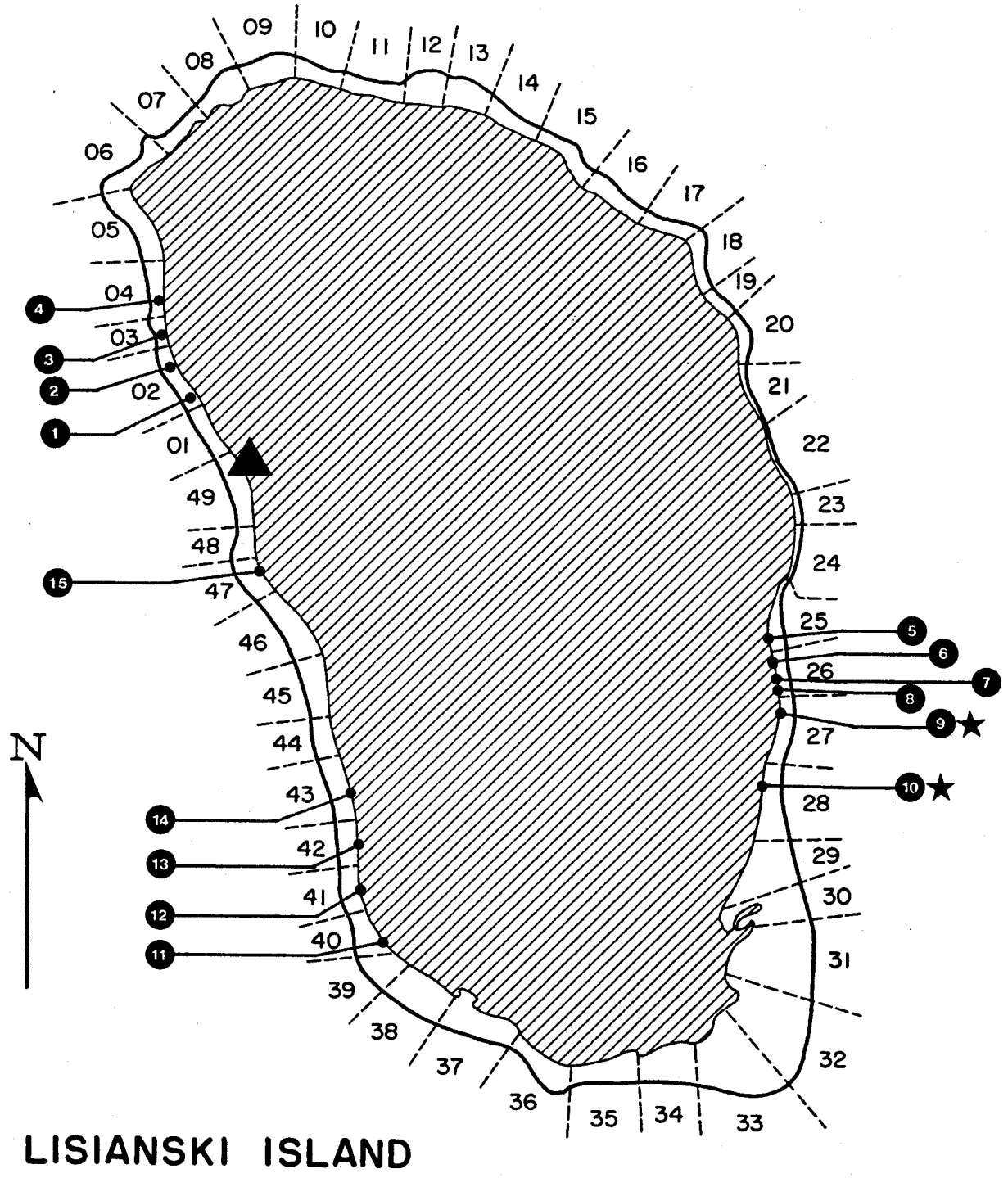

Figure 2.--Map of Lisianski Island showing 49 sectors and 1986 turtle nesting site locations. (▲ denotes campsite. ★denotes nesting sites dug during the August field camp.)

From 5 to 26 August, a circuit of the island was made twice daily for tag resightings and, on alternate days, included censusing. Reproduction was monitored, and all weaned pups were tagged. Monk seal injuries also were monitored, and necropsy samples were to be collected if a death occurred. Turtles were tagged and resighted on an opportunistic basis, and nesting activity was monitored. All nets and debris capable of entangling seals and turtles were inventoried and destroyed. Data on monk seals and green turtles were obtained during censuses and patrols of the island's perimeter.

Censuses

During the 5 to 26 August field camp, seal and turtle beach counts were conducted on alternate days, starting at approximately 1300 (Hawaii standard time), and averaged 1.5-2.0 h in duration. Two observers traveled in opposite directions, heading away from camp (sector 1/49 boundary) and met on the east side of the island in sectors 25-28. Observers alternated their directions traveled each census. No census was conducted on 3 May, and from 30 May to 2 June, only one formal census (about 5 h) was completed by one observer.

Census and coding instructions are described in Forsyth et al. (1988), and data were recorded on preprinted forms. These data included island, date, observer, data type (census or patrol), a summary of the weather conditions, and beginning and ending times. Data recorded for seals and turtles were sector location, size class, sex, tag numbers, beach position, and disturbance by observer, if any. The permanent identification number (ID) and percent body molt also were recorded for seals. More detailed information on size classification, seal identification, and molt status can be found in Stone (1984). Associations with other individuals, or with debris that could possibly entangle a seal or turtle, also were noted. It was standard procedure on all censuses and patrols to record any new births, injuries, deaths, and entanglements.

Patrols

One 6-h patrol of the Lisianski Island perimeter was completed on 3 May, and from 30 May to 2 June, three patrols (2.5, 10.5, and 4.5 h, respectively) were conducted. Twenty-four informal patrols also were conducted 5-26 August. Information recorded was the same as that for censuses, with the exceptions that not all individuals present were recorded and some association data were not collected. In August, two patrols were done on noncensus days, one in the morning and one in the afternoon, with starting times and durations varying each day. One or two observers recorded as many tag numbers sighted as possible as well as locations of untagged weaned pups. An effort was made to photograph and record those seals that had lost one of their two tags or had illegible numbers because of sand abrasion on one or both sides of a tag. Because field camp time was limited for identifying animals spending minimal time ashore, morning patrols also were conducted by one observer on census days. No taggings were done during these patrols in order to minimize disturbance prior to the afternoon census. Completion times of the morning patrols varied but were as close as 45 min before census began.

Individual Seal Identification

A small number of untagged seals in the Lisianski Island population were identified on the basis of scars and natural markings. Time was a limiting factor; hence, priority was given to identifying nursing females to gain information on individual reproductive histories. During patrols, scar patterns were drawn and photographs were taken of these females and injured animals. Photographs and scar drawings of previously "known" seals also were collected to update photo ID's. New ID numbers were assigned to seals only if they could not be matched with any seals from previous years but had relatively distinct scars, markings, or both. Scar cards and photos with the new ID numbers were filed for future reference.

Tagging Weaned Pups

Weaned pups were restrained by two or three persons to minimize the tagging time. A green, plastic Temple Tag[2] was placed on each hind flipper as described in Gilmartin et al. (1986). Tags had an engraved, resined letter and number on both sides and a unique, drilled hole pattern for year of birth. Axillary girth, straight body length (see Table 1), and other data were recorded on tagging cards for each pup. Pups were watched for 5 to 10 min after tagging to monitor their response to the procedure.

Turtle Research

Green turtles basking on the beaches or seen offshore were recorded during all censuses and most patrols. Foreflipper tags applied in previous years were read on an opportunistic basis while turtles were basking. One or two Inconel alloy tags were applied on untagged, immature turtles after they had been captured in shallow water with a scoop net; they were then measured (straight and/or curved carapace length and width) and released. Turtle nesting sites around the Lisianski Island perimeter that appeared to be from the 1986 nesting season were noted in August.

Debris Inventory and Disposal

In August, fishing nets, lines, and other debris that had accumulated on the Lisianski Island beaches and could possibly entangle monk seals and green turtles were sampled, and each item was cataloged. More detailed information on data collected can be found in Johanos and Kam (1986). This debris was then gathered into large piles on the beaches and burned. Samples were brought back to Honolulu for further analysis.

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[2]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Table 1.--Summary of pups born at Lisianski Island, 1986. (F = female, M = male, and ? = unknown.)

ID No.	Green tag		Sex	Date tagged	Measurements (cm)[a]		Birth date	Wean date
	Left	Right			AG	SL		
GL00	L00	L01	F	5/3	95	122	<5/3	--
GL02	L02	L03	F	5/3	115	136	<5/3	--
GL04	L04	L05	M	5/3	84	122	<5/3	--
GL06	L06	L07	F	5/3	83	125	<5/3	--
GL08	L08	L09	M	5/3	117	130	<5/3	--
GL10	L10	L11	M	5/3	117	129	<5/3	--
GL12	L12	L13	M	5/3	85	115	<5/3	--
GL14	L14	L15	F	5/30	--	--	<5/30	--
GL16	L16	L17	M	5/30	--	--	<5/30	--
GL18	L18	L19	F	5/31	111	136	<5/30	5/31
GL20	L20	L21	M	5/31	--	--	<5/30	--
GL22	L22	L23	M	5/31	--	--	<5/30	--
GL24	L24	L25	F	5/31	--	--	<5/30	--
GL26	L26	L27	M	5/31	--	--	<5/30	--
GL28	L28	L29	F	5/31	--	--	<5/30	--
GL30	L30	L31	F	6/2	--	--	<5/30	--
GL32[b]	L32	L33	M	8/7	109	132	<8/7	--
GL34[b]	L34	L35	M	8/10	--	136	<8/7	--
GL36[b]	L36	L37	F	8/10	115	138	<8/7	--
GL38[b]	L38	L39	M	8/15	--	--	<8/7	--
GL98[b]	Not tagged		?	Dead	--	--	<8/7	--
GL99[b]	Not tagged		?	Dead	--	--	<8/7	--

[a]AG = axillary girth and SL = straight length; measurements were taken at time of tagging.

[b]Two adult nursing females (GA01 and G105) were identified early in June; it is not known which of these six pups belonged to them, nor whether their pups were lost and never seen during the 2-mo period between observations on Lisianski Island in 1986.

RESULTS AND DISCUSSION

Monk Seals

Censuses

During the 10 censuses of Lisianski Island in 1986, seal beach counts excluding pups ranged from 76 to 107, with an average of 94. Counts including pups ranged from 88 to 121 and averaged 105. A more detailed census summary appears in Appendix B. These counts are higher than in 1982-85, with the average number of seals excluding pups ranging from 86 in 1983 to 68 in 1984 (Johanos and Kam 1986; Alcorn et al. 1988). Higher beach counts in August 1986 could have been due to more adult male seals hauling out because of their annual molt in late summer, in comparison to the 1982-85 field seasons when most or all of the research was conducted earlier in the summer. Adult males comprise the largest size-sex fraction in the Lisianski Island population (Stone 1984; Johanos and Kam 1986).

Pup Production

Twenty live monk seal pups (11 males and 9 females) were seen on Lisianski Island in 1986; all had been weaned prior to the August camp (Table 1). Two pup carcasses found during this time appeared to be of nursing size, but the sexes were unknown. The number of known births was greater than in 1984 (16 pups) and 1985 (15 pups; Alcorn et al. 1988). but still appeared to be below the numbers in 1982 (28 pups; Johanos and Henderson 1986) and 1983 (25 pups; Johanos and Kam 1986). Adult female migration to and from Lisianski Island may have somewhat influenced pup production in previous years, but that alone probably would not account for the low numbers in 1984 and 1985 (Alcorn et al. 1988). The 1984 and 1985 Lisianski Island camps were short, however, and pups that may have died or possibly emigrated would have been missed. Two of the three visits in 1986 were near the peak of the weaning period, allowing for more complete coverage.

When camp disbanded on 26 August, no pregnant females were apparent. Most adult females on the beaches had partially or completely molted, which occurs approximately 2 to 3 mo after weaning or earlier in the season for nonparturient adult females (Johnson and Johnson 1984). It is unlikely that any more pups were born in 1986, although births have occurred at least once in every month of the year in the NWHI (W. Gilmartin[3]).

Identification of Parturient Females

On 3 May, eight nursing females were observed and photographed, but a camera malfunction resulted in poor photographic quality, which precluded matching ID's. Of the

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[3]W. G. Gilmartin, Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396, pers. commun. September 1986.

three nursing adult females in early June, two were identified as GA01 and G105. Both pupped in 1982, and GA01 pupped again in 1983 (Johanos and Henderson 1986; Johanos and Kam 1986). It is not known whether these females gave birth in 1984 and 1985, because of the short camp durations. There were no nursing females in August 1986.

Tagged Pups

Twenty pups were tagged intermittently over the summer (Table 1), and all but one pup (GL20) were resighted in August. All 1986 tagged pups had retained both of their hind flipper tags when last seen.

Eleven pups tagged in 1982, 19 pups in 1983, 12 pups in 1984, and 14 pups in 1985 were sighted at least once throughout the 1986 field season (Table 2). First-year survival of the 1985 tagged pups was 100%. One pup, still nursing when the 1985 camp disbanded, was not tagged, and it is not known whether any pups were born later in the season. This first-year survivorship of 1985 pups is excellent; their large yearling size (subjective comparison with yearlings at other locations) may well indicate that food around Lisianski Island was not a factor limiting their survival.

Interisland Movement

Four monk seals moved to or from Lisianski Island during the 1986 field season (see Table 3). Three of these individuals (G027, TT14, and T25F) were seen in 1985 on Laysan Island, which is 110 nmi away, and immigrated to Lisianski Island since that time. The fourth individual, a 1985 Lisianski pup (GK24), moved to Laysan Island and was sighted during a 3-mo field camp there in 1986. Green algae throughout her pelage indicated she had spent much time at sea.

Deaths

There were two pup carcasses of unknown sex discovered in 1986 on Lisianski Island. Both appeared to be of nursing size; their skulls were broken and bones were scattered, with pieces of black pelage adhered to their skeletons. One carcass (GL98) was found near the sector 22/23 boundary in a rocky area, and the other carcass (GL99) was partially buried at the vegetation line in sector 19. A baculum was not found with either carcass but could have been lost.

Injuries

Fresh injuries inflicted upon seals could not be monitored for any great length of time because of the short duration of the camps. An adult female (temporary ID JUNE), attended by an adult male, was seen on 1 June with a large, deep, fresh dorsal wound. She was later seen in August, with the healing wound having partially closed. Another adult female had a healing back wound reopened in August, probably by an adult male. She bore

Table 2.--Number of pups born, tagged, and resighted at Lisianski Island, 1982-86.[a] (M = male, F = female, and ? = unknown.)

Year tagged	No. of known births	No. tagged that year	No. of tags resighted by year			
			1983	1984	1985	1986
	Total (M, F, ?)	Total (M, F)	Total (M, F)	Total (M, F)	Total (M, F)	Total (M, F)
1982	28 (16, 11, 1)[b]	13 (7, 6)	11 (5, 6)[c]	11 (5, 6)[d]	11 (5, 6)[e]	11 (5, 6)
1983	25 (7, 18)[f]	24 (6, 18)		21 (6, 15)[e]	20 (6, 14)	19 (5, 14)
1984	16 (10, 5, 1)[f]	15 (10, 5)			14 (9, 5)	12 (9, 3)
1985	15 (6, 9)	14 (5, 9)				14 (5, 9)[e]
1986	22 (11, 9, 2)[b]	20 (11, 9)				

[a]Data for 1982-85 births and taggings are from the following sources: 1982, Johanos and Henderson (1986); 1983, Johanos and Kam (1986); 1984 and 1985, Alcorn et al. (1988).

[b]Total includes two dead, nursing-sized pups.

[c]There were 24 pups from 1982 resighted: 11 were identified by tags, and 13 were identified by bleach marks applied in 1982 on untagged pups.

[d]Total includes one pup not seen that year at any location but resighted in 1985.

[e]Total includes a Lisianski pup resighted at Laysan Island that year.

[f]Total includes one dead pup.

Table 3.--Interisland movement of monk seals to and from Lisianski Island in 1986. (A = adult, S = subadult, and J = juvenile; M = male and F = female.)

ID	Tags		Tag color	Size and sex	Movement from		Movement to	
	Left	Right			Location	Date last seen	Location	Date first seen
GK24	K24	K25	Green	JF	Lisianski	7/13/85[a]	Laysan	5/10/86[b]
G027	027	028	Green	SF	Laysan	7/7/85[c]	Lisianski	8/10/86
TT14	T14	T72	Tan	SM	Laysan	11/26/85[c]	Lisianski	5/31/86
T25F	--	--	--	AF	Laysan	7/28/85[c]	Lisianski	8/18/86

Data are from the following sources:

[a]Alcorn et al. (1988).

[b]Alcorn, D. J., and R. L. Westlake. The Hawaiian monk seal on Laysan Island, 1986. Manuscr. in prep. Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.

[c]Johanos and Austin (1988).

a right hind flipper metal tag that was not read, but based on sightings in earlier years, her ID was probably GA77 (tag A1011).

At least six individual adult and subadult females were seen with older back wounds during the August camp. The wounds varied in size, severity, and degree of healing and appeared to be of the type inflicted by adult males, probably earlier in the season or from the year before.

Entanglements

In August, two seals were found entangled in debris. A weaned pup (GL28) was observed entangled in a pile of polypropylene netting attached to a large, heavy pile of mooring line in the wave wash of sector 19. The pup's neck was wrapped around with a strand of netting in front of her foreflippers, slightly cutting into the blubber layer (Fig. 3A). The pup was photographed and released. A subadult male seal (TT14) was seen partially entangled in a polypropylene rope in sector 25 while hauled out on the beach (Fig. 3B). The rope appeared tight on top of the seal's nose and was photographed, but when released, it was found it would not have restricted his movement.

Green Turtles

A total of eight turtles were identified by tags. Five of these had tags from previous years, and three were newly tagged in 1986 (Table 4). Fifteen turtle nesting sites were mapped and inventoried in 1986 (Fig. 2). Two of these were dug while observers were on the island in August; there were no turtle hatchings observed during this time, although effort was not applied to monitor for hatchings. A dead adult turtle (sex unknown) was found half-buried and partially decomposed at midbeach in sector 29. Tags were not found.

Debris Inventory

During the 1986 field season, 174 pieces of net and debris items capable of entangling seals and turtles were removed from the beaches on Lisianski Island. Each item was sampled and inventoried. The remaining debris was put into piles and burned at the end of the August camp. Further analysis as to type and origin of the debris is ongoing and will be presented elsewhere.

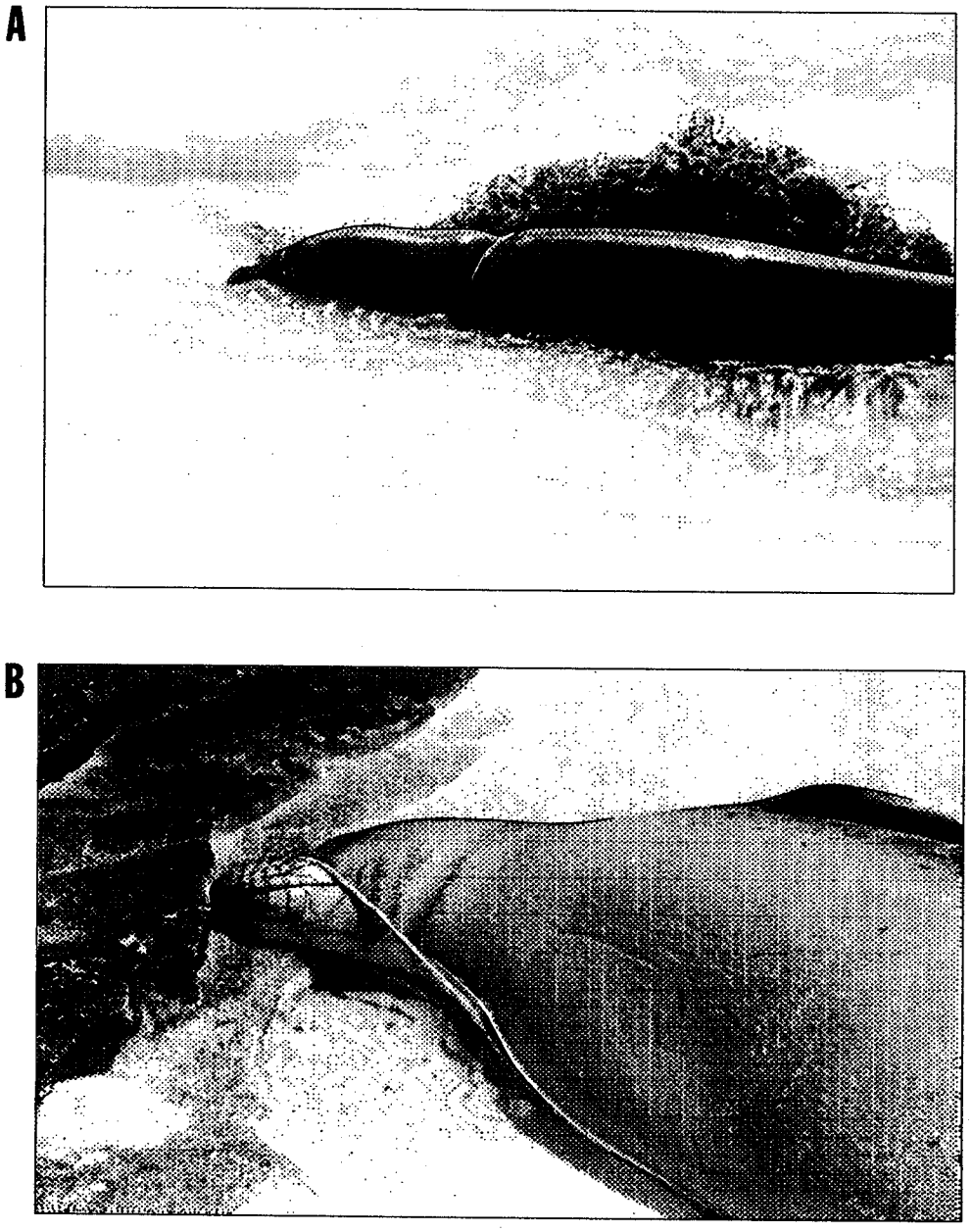

Figure 3.--Seals entangled in debris. (A) Entangled weaned pup in a pile of polypropylene netting, and (B) partially entangled subadult seal in polypropylene rope.

Table 4.--Green turtles resighted and tagged at Lisianski Island, 1986. (A = adult and I = immature; M = male, F = female, and ? = unknown.)

Tag No.		Date	Sector			Carapace measurement (cm)			
						Straight		Curved	
Left	Right	resighted	No.	Size	Sex	Length	Width	Length	Width
				Resightings					
6768	--	8/22	09	A	M	--	--	--	--
--	A494[a]	8/21	27	A	F	--	--	--	--
6477	--	8/12	09	I	?	--	--	--	--
--	8666	8/09	27	I	?	--	--	--	--
--	2851	8/22	09	I	?	--	--	--	--
				Taggings					
8669	--	8/13	49	I	?	40.0	--	41.7	36.5
8670	8671	8/13	49	I	?	45.0	37.2	--	--
8672	8673	8/13	49	I	?	39.4	31.6	--	--

[a]U.S. Fish and Wildlife tag.

ACKNOWLEDGMENTS

We thank the crews of the fishing vessel *Feresa* and the NOAA ship *Townsend Cromwell* for transporting supplies and personnel to and from Lisianski Island. Their help in assisting the camps was greatly appreciated. The U.S. Fish and Wildlife Service (USFWS) provided a lot of support and made the 30 May-2 June field camp possible. We would like to especially thank Tim Gerrodette of NMFS and Joel Simasko (USFWS) for participating in the 1986 Lisianski Island study.

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APPENDIXES

Appendix A.--Itinerary for the 1986 Lisianski Island fieldwork.

Date	Event
4/29	The NOAA ship *Townsend Cromwell* departs Honolulu with NMFS Honolulu Laboratory and U.S. Fish and Wildlife Service (USFWS) personnel on board.
5/3	The *Townsend Cromwell* arrives at Lisianski Island and disembarks Honolulu Laboratory personnel (D. Alcorn and R. Westlake), USFWS personnel and volunteers (E. Bean, A. Marshall, and J. Simasko). Alcorn, Westlake, and Simasko circuit the island while others remain near landing cove. The Moana Productions film staff comes ashore with *Townsend Cromwell* crew members in the afternoon. Everyone embarks the *Townsend Cromwell* by 1715, and the ship departs for Laysan Island.
5/30	The fishing vessel *Feresa* arrives at Lisianski Island with Honolulu Laboratory personnel (T. Gerrodette) and USFWS personnel (D. Hu, K. McDermond, and T. Ohashi), and field research begins.
6/2	Shore party ends research and disbands field camp, leaving Lisianski Island via the *Feresa* for Pearl and Hermes Reef.
8/5	The *Townsend Cromwell* arrives at Lisianski Island with Alcorn and Westlake and USFWS personnel (Bean, Marshall, M. Morin, and P. Siepmann). Personnel and crew members disembark with supplies and help set up field camp. The *Townsend Cromwell* departs the same day with crew and staff while Westlake and Siepmann remain to conduct research.
8/7	Monk seal and green turtle research formally begins.
8/26	Research ends, and Westlake and Siepmann disband camp; embark the *Townsend Cromwell* with supplies and head for Pearl and Hermes Reef to pick up Honolulu Laboratory field camp there. Arrive 27 August and depart same day for Midway. Arrive Midway 28 August, and all Honolulu Laboratory and USFWS personnel arrive back in Honolulu via MAC flight.

Appendix B.--The 1986 Lisianski Island seal census summary. (M = males, F = females, and ? = unknown.)

	Non-pups									Pups						Total		
	Adult			Subadult			Juvenile			Weaned			Nursing					
Date	M	F	?	M	F	?	M	F	?	M	F	?	M	F	?	Nonpup	Pup	Grand
6/01	23	10	20	13	14	13	7	3	4	5	5	1	1	0	2	107	14	121
8/08	20	3	9	14	6	11	8	3	2	6	5	1	0	0	0	76	12	88
8/10	26	5	12	19	7	7	8	6	1	6	4	0	0	0	0	91	10	10
8/12	24	4	18	13	4	7	9	4	2	8	5	0	0	0	0	85	13	98
8/14	32	6	23	7	6	12	7	4	2	5	4	1	0	0	0	99	10	109
8/16	28	3	23	8	7	10	6	2	3	7	4	0	0	0	0	90	11	101
8/18	30	6	27	9	8	7	6	5	5	6	5	1	0	0	0	103	12	115
8/20	35	9	22	11	3	12	7	3	5	7	4	0	0	0	0	107	11	118
8/22	34	9	22	8	5	6	9	2	1	7	4	0	0	0	0	96	11	107
8/24	16	2	40	5	1	14	4	2	0	4	3	0	0	0	0	84	7	9

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